Research Proposal of the Thesis Entitled

Risk and Safety Hazards involved in Material Handling Construction Projects concerning Fertilizer Industries

Submitted for the award of the Degree Of

Doctor of Philosophy

by

Subrota Ghosh
Enrollment No. 202302003

Under Guidance of

Dr. Preeti Kulshrestha

Professor

In the

Unitedworld Institute of Management

Karnavati University, Gandhinagar

(August, 2024)

1. Introduction

The construction industry is a huge and involves huge workforce from organized and unorganized sectors. For the revolutionary development of a country, construction is a basic need, by which all the infrastructures and industrial revolution are possible. In the Industrial Revolution, the Fertilizer industry played a significant role. This industry itself is a large industry by which developing countries like India are getting ensured foods for everyone. The farmer fully depends on fertilizers for cultivation and growing crops. In Fertilizer industry, the material handling has a very important role as by this process fertilizers reach to overall country from the plants. In material handling process has several parts 1) Conveying of Fertilizers from Plants to Railway Siding, 2) From Plant Railway siding to railway siding of various Depots, 3) From Depot to Supplier, and 4) From Supplier to Farmers. Out of the above process main important part is Plant to Plant Railway siding as huge quantities of materials are shifting from plants to Railway Siding regularly 24X7 and that industry needs an automated huge capacity material handling plant that involved Silo, Conveyor Gallery, Bagging Stations, Railway Platforms, etc. In earlier days all were done manually which was a very time-consuming and slow & hectic process. Nowadays in the last 15 years the scenario has changed as people need proper food regularly and for that need prompt supply of fertilizers to the farmers. Therefore the Fertilizers companies are constructing rapidly for material handling projects one by one to fill the demand and supply gaps. In a material handling project, there are various safety factors involved which need to be addressed properly.

Large-scale enterprises depend on material-handling construction projects, which include construction of silos, warehouses, conveyor galleries, railway platforms, and road transport infrastructure.

2. Review of Literature

Yu Sum, Dongping Fang (2008): This study title is "Safety Risk Identification and Assessment for Beijing". The study is carried out on construction management safety in the Beijing Olympics. During the Beijing Olympics, several constructions for events were carried out in which the safety norms were followed and the observations were found that have been studied and 57 risk hazards were identified and analysed. Based on the above, developed a risk assessment model for evaluation of the status of risks on site safety by AHP – a rating method.

Van WH Fung, Vivian WY Tam (2009): The study title is "Developing a Risk Assessment Model for construction safety". The study was carried out in Hong Kong construction industries. The study was carried out based on the data of Labour Department of Hong Kong and found that the rate of accidents is 68.1 on 1,000 Labour which is comparatively much higher than Singapore i.e. 9.4 per 1,00,000 Labour. This study suggests a Risk Assessment Model to help safety professionals for reducing of accidents at the site.

Sai X. Zeng1, Chun M. Tam2 (2010): The study title is "Integrating Safety, Environment and Quality Risks for Project Management". In this study failure of ISO and OHS management for Environment & Safety are studied and found that although these modules are available with all the agencies but public is facing environment & Safety hazards. Therefore failure analysis was carried out and suggested how to reduce the hazards.

Adel Badri, Sylvie Nadeau (2011): The study title is "Proposal of a risk-factor-based analytical approach for integrating occupational health & safety into in Project Risk Evaluation". The study is focused on the effective implication of OHS policy since the beginning. By this study, it is observed that due to the lack of seriousness of following OHS policy, the sites are facing more risk hazards. This study prepared an Analytical Hierarchy Process (AHP) by which OHS can be implemented in steps of 1) Risk identification, 2) Risk assessment, and 3) actions.

SamanAminbakhsh, Murat Gunduz (2013): The study title is "Safety Risk Assessment Using Analytic Hierarchy Process (AHP) during Planning and Budgeting of construction projects". This study is basically for the planning of safety model cost by hierarchy process analytically. Various real-time project safety cost was analysed and it was found that if any accident is happened the cost of project could be increased by up to 15%, whereas if the budget was spent more during execution it would be beneficiary to the companies. This study suggested how to make a robust method for prioritization of safety risks for creating a rational budget for safety & risk during the planning & budgeting stage of construction projects.

Shen, Yuzhong, Tuuli, Martin (2015): The study title is "Towards a Model for forming psychological safety climate in construction project management". This study is carried out basically to make a model by which people should have a behavioural change towards safety & risk hazards in construction sites. Various data are analysed and made a model for which the

companies can make Safety-specific organizational structure, Client Safety involvement, Transformation of leadership, and Individual collectivism.

Ruoyu Jin, Patrick X.W. Zou (2018): The study title is "A science mapping approach based review of construction safety research". In this study three-way approach was adopted i.e. review of bibliography, scientific analysis and discussion in details. After detailed analysis summarize the data. The scientometric analysis informed that the safety hazards can be reduced and safety performance can increase by digital technology and data analysis for safety management. Also by in-depth discussion, it is found that by improving of climate and culture for safety, the safety performance can be increased.

Yu Zhao, QuanChem (2019): The study title is "Deep Learning for Risk Detection and Strategy Tracking at Construction Sites". This study basically for intelligence detection technology to be used for safety observation instead of manual vision in construction projects. The Internet of Things (IOT) is an emerging technology of intelligent detection in computer vision. The detail study was divided into two sections i.e. Detection of safety officer and Tracking of pedestrian. The YoloV3 method is used for target detection for into a regression problem.YOLOv3 is a typical supervised learning algorithm. By this method remotely detect the Safety Officer. By the other method namely Kalman Filter and Hungarian algorithm is used to achieve pedestrian tracking. After going through the process data analysis has been done and found that the accuracy of detection is more than the manual method and warning signalling is also possible by this process.

Nasir B. Siraj, S.M. ASCE (2019): The study title is "Risk Identification and Common Risks in Construction: Literature Review and Content Analysis". In the literature, mainly studied about risk identification by wide array of tools and techniques exist. The tools are a review of documentation, gathering of information about various techniques, taking interviews, and analysis for root cause, questionnaires, other analysis like checklist, assumptions, making diagrams, analysis of strength – weakness - opportunity - threats (SWOT). Also analysis of expert judgment, fault tree, decision tree, failure mode and effect etc. In this study it is observed that the most of the skilled persons are known about risk identification tools and tackles. In this study, it is found that the casual interaction and dependencies between risk and risk assessment the risk allowance. Therefore required to be further dynamic analysis for dynamic behaviour, casual interactions and dependencies to find out the impact of risks on total project cost.

Meera Mohan, Shibi Varghese2019: The study title is "Artificial Intelligence Enabled Safety for Construction Sites". The study revealed the work environment of the construction site is very complex and thousands of workers are working at the site. There is always chance of fatal accidents and injuries. To protect from these accidents BIM can helps like checking the class detection but it's also not a fool proof solution as checking is done manually, which caused chance of error. Artificial Intelligence (AI) is a better option in this case to easily monitor of safety. It's an object detection process that analyses the images. By AI the BIM method is become a proactive method for identification of safety hazards.

Venkat Santosh Kumar, R. Sankarlal (2020): The study title is "Detection of Personal Protective Equipment (PPE) Compliance on construction site using computer vision deep learning technique". This is also a study of detection of safety violence through computer vision. In this study by using YoloV3 (You Only Looks Once) method detection of non-availability of PPE by workmen can be detect and based on that warning can be given and a necessary remedy can done. In this process additionally CCTV camera is also added for monitoring. For process of all these method appropriate training arrangement would be made. In this study suggested monitoring of safety violation can be done in two ways and it is more effective and necessary protection can be done quickly. By this safety hazards can be reduced at construction site.

Maryam Alkaissy, MehrdadArashpour (2020): The study title is "Safety Management in Construction: 20 years of risk modelling". The study is basically done by collecting data from the last 20 years and analysing and systematic review done and suggested for improvement so that risk hazards at the site can be reduced as the highest rate of fatalities and injuries in construction sectors. It is found that simulation and optimization techniques are advanced day by day since 20 years however it can be further improve when it's come for modelling of risks regarding safety. The technique is systematically reviewed and meta-analysis also done. The study suggested that due to failure of model of project safety risks the hazardous

Mariam Akinlolu, Theu C. Haupt (2020): The study title is "A bibliometric review of the status and emerging research trends in construction safety management technologies". In this study, it is observed that after implementation of several technologies like virtual reality, databases, geographic information systems, building information modelling, unmanned aerial

vehicle, computer-aided design, automation, laser technology, photography, and sensor technologies, etc. safety is not fully secured for Labour workforce. There are stringent guidelines are there from Govt. and Non-Govt. organisation even though accident and risk hazards are not controlled properly.

In this study for analysis VOS viewer software is used. The study is based on US, UK and other western countries. A detail Bibliography is prepared by this study for implantation at the site for reducing of Safety Hazards.

Zhenhua Zhu, Amrita Dutta (2021): The study title is "Exoskeletons for manual material handling – A review and implication for construction applications". The study said about body parts injuries review. This is the first paper that reviewed the existing exoskeleton technologies and analysed their potential for works of manual handling in construction projects. The review results indicated that the exoskeleton use may be help to reduce physical fatigue and muscle activity and loading also. However extra risks of load shifting and redistribution of a wearer's centre of gravity which is required to be further assessed in a practical workplace. It is also not clear whether by using an exoskeleton, the achievement of productivity is possible.

Syed Ammad, Wesam Salah Alaloul (2021): The study title is "Personal Protective Equipment (PPE) usage in Construction Projects: A Scientometric Approach". In this study, the safety hazards are divided into two part in Human & Physical factor. The study is basically for construction industry of USA. The findings by the study is awareness of safety, training lacuna, commitment of corporate, lack of technical advice, illegal activity, non-availability of first-aid measures, lack of stringent safety rules, PPE not followed properly, lack of safety and less numbers of equipment cause accidents. In Great Britain construction industry, several deaths are occurred due to this however from 2016 to 2019, most 32% death rate is downgraded due to negligence and not following proper PPE. Hazard management hierarchy method is used in the construction industry to minimise the risks and hazards. During the study, it was observed that still; proper PPE & Safety Devices are still not used properly. In modern era for rapid completion of projects, risks are considerably more and therefore compulsory using of PPE is a must.

Jack CP Cheng, Peter Kok Yiu Wong (2022): The study title is "Vision-based monitoring of site safety compliance based on worker re-identification and personal protective equipment classification". This study is for deep learning of safety hazards at construction sites and

making a visual monitoring system to reduce the safety hazards at the site. Generally, workers move around large sites, their movement can be continuously tracking through multiple cameras would enable more comprehensive behavioural analyses. Therefore, this paper proposes a framework for monitoring the compliance of safety among workers, by combining worker re-identification and PPE classification. Developed a Deep learning-based approaches to address the challenges for these two tasks. This study found combining the worker RID and PPE classification results, developed a workflow to catch any incident of individual workers not wearing the required PPE, for analysis of safety compliance of workers in overall site.

3. Problem Definition

In fertilizers industry material handling construction projects is a difficult area where companies required stringent compliance of DISH (Directorate of Industrial Safety & Health). However, numerous companies operating in fertilizers sector have minimal compliance with regulatory guidelines. On account of non-compliance and assessment of potential risks associated with the projects lead to many fatal accidents, and minor & major injuries happening at work sites. The labour workforce engaged in such projects is forced to work under vulnerable conditions where their lives are always at risk. The present study is an attempt to explore risks associated with the projects and identify the present conditions of the labour force working in this industry.

4. Research Questions

1. What is the rate of fatal accidents happening at the site due to non-compliance with PPE?

2. How many safety violations have been observed and reported in the last 5 years?

3. What kind of risks involved in material handling projects in the Fertilizer industries?

5. Need and Significance of Study

The study is essential to assess the situation of labor workforce for engaged in material handling construction projects with reference to the fertilizers industry. The life of the Labor/workforce is vulnerable in this particular industry. In the present study researcher identifies the situations of the labour work force engaged in material handling construction projects and will suggest

some viable solutions to the genuine problems of workforce to the selected industries.

6. Research Objectives

The aim of the research is to study "Risk Management Practices in the Material Handling Projects with key focus on Fertilizers Sector".

This study will be carried out with the following objectives:

(i) To identify the risks involved in Material Handling Projects of Fertilizers industry.

(ii) To assess the present working conditions of the labor workforce involved in Material Handling Projects of the Fertilizer industry.

(iii) To identify noncompliance practices of construction projects as mentioned by DISH (Directorate of Industrial Safety & Health) guideline.

7. Hypotheses

H01: Working condition of labor workforce engaged in material handling projects of the fertilizers industry is not satisfactory.

Ha1: Working condition of labor workforce engaged in material handling projects of fertilizers industry is satisfactory.

H02: Projects of material handling of fertilizers industry do not implemented DISH guidelines.

Ha2: Projects of material handling of the fertilizers industry do implement DISH guidelines.

8. Research Methodology

To conduct the present study researcher will consider both quantitative & qualitative methods. This study is a kind of exploratory and observational research. To conduct the study primary data will be collected through an administered questionnaire on a Likert 5.0 scale from various respondents of the labor workforce and safety officers. The data will be collected from major companies operating in fertilizers sector in the Southern-Western part of India. Collected data will be analysed through various parametric tests and non-parametric test by the software SPSS.

9. Visible Research Outcomes

This research outcome will be beneficial to the labor workforce and regulations committees.

The present research will suggest the viable solution to handle the various kind of risk involved in material handling projects pertaining to fertilizers industries. The study will help safety officers/observers to get the solution to mitigate the risk involved in project handling.

10. Tentative Chapter Plan

1. Introduction
2. Review of Literature
3. Research methodology
4. Data Analysis & Interpretation
5. Research Conclusions & Suggestions

11. Scope and Limitations of the Study

1) This study is only limited to Material Handling Construction Projects of Fertilizer Industry.

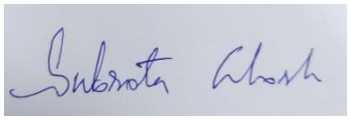
2) Target respondents are limited.

References

- Akinlolu, M., Haupt, T. C., Edwards, D. J., & Simpeh, F. (2022). A bibliometric review of the status and emerging research trends in construction safety management technologies. *International Journal of Construction Management*, *22*(14), 2699-2711.
- Alkaissy, M., Arashpour, M., Ashuri, B., Bai, Y., & Hosseini, R. (2020). Safety management in construction: 20 years of risk modeling. *Safety science*, *129*, 104805.
- Aminbakhsh, S., Gunduz, M., & Sonmez, R. (2013). Safety risk assessment using analytic hierarchy process (AHP) during planning and budgeting of construction projects. *Journal of safety research*, *46*, 99-105.
- Ammad, S., Alaloul, W. S., Saad, S., & Qureshi, A. H. (2021). Personal protective equipment (PPE) usage in construction projects: A scientometric approach. *Journal of Building Engineering*, *35*, 102086.
- Badri, A., Nadeau, S., & Gbodossou, A. (2012). Proposal of a risk-factor-based analytical approach for integrating occupational health and safety into project risk evaluation. *Accident Analysis & Prevention*, *48*, 223-234.
- Delhi, V. S. K., Sankarlal, R., & Thomas, A. (2020). Detection of personal protective equipment (PPE) compliance on construction site using computer vision based deep learning techniques. *Frontiers in Built Environment*, *6*, 136.
- Fung, I. W., Tam, V. W., Lo, T. Y., & Lu, L. L. (2010). Developing a risk assessment model for construction safety. *International Journal of Project Management*, *28*(6), 593-600.Sai X. Zeng1,
- Jin, R., Zou, P. X., Piroozfar, P., Wood, H., Yang, Y., Yan, L., & Han, Y. (2019). A science mapping approach based review of construction safety research. *Safety science*,
- Mohan, M., & Varghese, S. (2019). Artificial intelligence enabled safety for construction sites. *Int. Res. J. Eng. Technol.(IRJET)*, *6*(6), 1-6.
- Shen, Y., Tuuli, M. M., Xia, B., Koh, T. Y., & Rowlinson, S. (2015). Toward a model for forming psychological safety climate in construction project management. *International journal of project management*, *33*(1), 223-235.
- Siraj, N. B., & Fayek, A. R. (2019). Risk identification and common risks in construction: Literature review and content analysis. *Journal of construction engineering and management*, *145*(9), 03119004.
- Sun, Y., Fang, D., Wang, S., Dai, M., & Lv, X. (2008). Safety risk identification and assessment for Beijing Olympic venues construction. *Journal of management in engineering*, *24*(1), 40-47.
- Wong, K. Y., Leung, P. H., & Cheng, J. C. P. (2023). *U.S. Patent Application No.*

17/895,373.

- Zeng, S. X., Tam, C. M., & Tam, V. W. (2010). Integrating safety, environmental and quality risks for project management using a FMEA method. *Engineering Economics*, *66*(1).Adel Badri a, Sylvie Nadeau (2011).
- Zhao, Y., Chen, Q., Cao, W., Yang, J., Xiong, J., & Gui, G. (2019). Deep learning for risk detection and trajectory tracking at construction sites. *IEEE Access*, *7*, 30905-30912.
- Zhu, Z., Dutta, A., & Dai, F. (2021). Exoskeletons for manual material handling–A review and implication for construction applications. *Automation in Construction*, *122*, 103493.



Signature of the
Research Scholar

Signature of the
Research Supervisor